REMARKS

The Office Action dated April 21, 2004, has been received and reviewed.

Claims 1 through 68 are currently pending and under consideration in the above-referenced application. Of these, claims 1 through 38, 40 through 47, 49 through 55, 57, 59 through 66, and 68 are rejected. The indication that claims 39, 48, 56, 58, and 67 recite allowable subject matter is gratefully acknowledged.

Claims 37 through 40, 53, and 56 have been canceled without prejudice or disclaimer.

New claims 69 through 81 have been added.

Reconsideration of the above-referenced application is respectfully requested.

Rejections Under 35 U.S.C. § 103(a)

Claims 1 through 38, 40 through 47, 49 through 55, 57, 59 through 66 and 68 are rejected under 35 U.S.C. § 103(a).

M.P.E.P. § 706.02(j) sets forth the standard for a rejection under 35 U.S.C. § 103(a):

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Takeda in View of Landau

Claims 1 through 34, 49, 50, 53 through 55 and 57 are rejected under 35 U.S.C. § 103(a) for reciting subject matter which is assertedly unpatentable over that taught in U.S. Patent 5,748,198 to Takeda et al. (hereinafter "Takeda"), in view of teachings from U.S. Patent 6,529,207 to Landau et al. (hereinafter "Landau").

Takeda lacks any teaching or suggestion of culling back facing polygons of a three-dimensional digital image. The teachings of Takeda relate to methods for causing

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hardware that would not otherwise display back facing polygons to display selected back facing polygons. In so doing, the method that is taught in Takeda includes evaluating data that corresponds to at least the selected back facing polygons. If the data corresponding to these back facing polygons were culled, it could not be evaluated or displayed.

Takeda notes that it is often desirable to display "reflected" images that are located "behind" an observer. Col. 1, lines 53-64; *see also* FIG. 12. Mirrors reflect images that, although located "behind" an observer, would be back facing relative to the direction from which an observer views. At the time the application which resulted in Takeda was filed, however, most available hardware was only capable of depicting "front facing" polygons. Col. 2, lines 2-8. Thus, polygons which were "back facing" relative to the direction of an observer's viewpoint could not be depicted; *i.e.*, back facing polygons are automatically disregarded by the hardware. *Id.;* col. 2, lines 8-17. The result was that "mirror images" or any other images (*e.g.*, interior surface images) that were formed by back facing polygons could not be displayed (col. 2, lines 18-24) without doubling the number of polygons for a particular three-dimensional digital image and, consequently, slowing down the rate at which hardware displays and refreshes images thereof (col. 2, lines 42-45).

Although the hardware disregards data for back facing polygons, Takeda does not teach or suggest that such data is actually culled. If it were, the processes that are taught in Takeda would not work, as they require an evaluation of back facing polygons and manipulation of the data corresponding to selected back facing polygons for the purpose of displaying them.

Accordingly, the teachings of Takeda are drawn to methods for displaying back facing polygons, such as in the image of a rear view mirror or interior surfaces of hollow objects (*e.g.*, bubbles, balloons) into which a user's viewpoint extends, on hardware that could not otherwise display back facing polygons. Col. 2, lines 57-62. The methods of Takeda regarding this aspect of the teachings thereof include using an orientation (*i.e.*, front facing or back facing) "flag" which has been set for each polygon of a digital image, based on the orientation of that polygon relative to the direction from which an observer is viewing the digital image, in conjunction with one or both of a vertical inversion flag and a horizontal inversion flag. Col. 3, lines 19-38; col. 8, lines 46-64. If an inverted image is to be viewed, the coordinates of each polygon in the image

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are also inverted, the orientation flag is also changed, effectively changing back facing polygons to inverted front facing (*i.e.,* viewable) polygons and vice-versa. *Id.*

Based on the foregoing, it appears that the "sorting" discussed at col. 16, line 2, to col. 17, line 10, merely refers to sorting the polygons based on their relative Z-axis positions (*i.e.,* distance from the "location" of an observer), independent from a determination of whether or not each polygon is front facing or back facing.

Landau teaches anti-aliasing techniques. In addition, Landau mentions use of a back face culling processes that include "computing the area . . . of each triangle as the cross product of the X, Y projections of two of the triangle sides." Col. 5, line 67, to col. 6, line 3. A sign of the cross product term indicates whether or not that triangle is front facing or back facing. Col. 6, lines 3-11.

It is respectfully submitted that there are a number of reasons that a *prima facie* case of obviousness has not been established against any of claims 1 through 34, 49, 50, 53 through 55, or 57, as is required to maintain the rejections of these claims under 35 U.S.C. § 103(a).

No Reasonable Expectation of Success

First, it is respectfully submitted that one of ordinary skill in the art would have had no reason to expect that the asserted combination of teachings from Takeda and Landau would have been successful.

In particular, Takeda teaches the evaluation of back facing polygons to determine which back facing polygons should be displayed. No back facing polygons are displayed. Landau, in contrast, teaches processes for culling, or eliminating, back facing polygon data. If the processes of Takeda were modified in accordance with the teachings of Landau, the data that corresponds to back facing polygons would be eliminating, thereby leaving no such data to display as mirror images (*e.g.,* in a rear view mirror of a car) or internal surfaces (*e.g.,* of a bursting balloon).

Thus, one of ordinary skill in the art would have no reason to expect that incorporating the teachings of Landau into the method of Takeda would be successful or result in the methods recited in claims 1 through 16, the digital object-rendering systems of claims 17 through 34, or the digital image-rendering methods recited in claims 49, 50, 54, 55, and 57.

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Takeda Teaches Away from the Combination of References, As Asserted

Second, it is respectfully submitted that Takeda teaches away from combining the teachings thereof with those of Landau in the manner that has been asserted. Specifically, at page 18 of the outstanding Office Action, it is has been asserted that one of ordinary skill in the art would have been motivated "to combine the polygon data processing techniques used in Takeda . . . with the back-face culling system of Landau . . . in order to implement a system utilizing the above-techniques to render *only front-face polygons*, rather than those which are hidden from view . . ."

The entire purpose of the process taught in Takeda is, however, to display polygons that would otherwise be hidden from view. Thus, Takeda teaches away from combining the teachings thereof with teachings from a reference, such as Landau, that would prevent rendering or displaying back facing polygons.

Therefore, it is respectfully submitted that the Office has not established a *prima* facie case of obviousness against any of claims 1 through 34, 49, 50, 54, 55, or 57 under 35 U.S.C. § 103(a).

There Would Have Been No Motivation to Combine the Teachings of Takeda and Landau

Third, it is respectfully submitted that one of ordinary skill in the art would not have been motivated to combine the teachings of Takeda and Landau in the manner that has been asserted. In particular, it has been asserted that one of ordinary skill in the art would have been motivated, prior to the filing date of the above-referenced application, to combine teachings from Takeda and Landau to render obvious the methods and systems that are recited in claims 1 through 34, 49, 50, 54, 55, and 57.

As a back face culling method of the type taught in Landau would eliminate the data corresponding to back facing polygons, some of which are displayed in accordance with the method taught in Takeda, it is respectfully submitted that one of ordinary skill in the art would not have been motivated to combine the teachings of Takeda and Landau in the manner that has been asserted.

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Moreover, each of claims 1 through 34, 49, 50, 54, 55, and 57 mentions sorting positional data of three vertices that are sequentially positioned around the periphery of an analyzed polygon. Claims 1 through 34 more specifically recite that the data is sorted based on relative vertical positions of the at least three vertices of each polygon.

Sorting is an affirmative act of arranging the data (American Heritage College Dictionary, Tenth Edition (1997)) based on relative vertical orientations of the data, then calculating a cross product term for the polygon, as well as determining an orientation of the polygon.

Takeda involves a process in which the location of each polygon has already been determined along the z-axis, relative to a particular viewpoint (*e.g.,* a driver's position in the seat of a car). The orientation of each polygon has also apparently been predetermined, presumably by conventional processes. Takeda does not, however, teach or suggest that the data corresponding to the vertices of a polygon is sorted based on relative positions of the vertices. Takeda, therefore, lacks any teaching or suggestion that would be of any use or motivation to one of ordinary skill in the art with respect to developing a process for determining whether or not the polygons of a digital image are front facing or back facing.

Landau, which mentions back face culling, merely teaches a well-known conventional process for determining whether or not polygons are front facing or back facing. Notably, that process includes calculation of a cross product term, but lacks any sorting of data of at least three vertices based on their relative positions (vertical or otherwise) prior to effecting the cross product term calculation.

Although it has been asserted at page 19 of the outstanding Office Action that all data that is "input into a calculation [is] sorted or arranged in some way," the act of "sorting" is defined as "[t]o arrange . . ." American Heritage College Dictionary, Tenth Edition (1997). As Takeda and Landau do not teach or suggest an affirmative arrangement of the data based on the relative positions of the vertices of each polygon, it is respectfully submitted that Takeda and Landau both lack any teaching or suggestion that the data may be sorted.

Further, it is respectfully submitted that, before the filing date of the above-referenced application, one of ordinary skill in the art would not have been motivated to sort data of at least three vertices of each polygon of a digital image prior to calculating the cross product term of

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that polygon and determining whether or not the polygon should be displayed because Takeda, Landau, and the knowledge that was generally available in the art at that time do not provide any suggestion or motivation that a cross-product term that has been calculated on the basis of data sorted by relative vertex positions would have been useful; the mere calculation of the cross-product term was, at that time, deemed sufficient for determining whether a polygon was front facing or back facing.

It is, therefore, respectfully submitted that one of ordinary skill in the art would have found no motivation or suggestion in Takeda, Landau, or the knowledge that was generally available in the art to combine the teachings of Takeda and Landau in the manner that has been asserted.

From the teachings of the references that the Office has relied upon in making its rejections, it appears that any such motivation to combine the teachings of these references could only have been improperly gleaned from the teachings of the above-referenced application.

Accordingly, it is respectfully submitted that a *prima facie* case of obviousness under 35 U.S.C. § 103(a) has not been established against any of claims 1 through 34, 49, 50, 54, 55, or 57.

Takeda and Landau Do Not Teach or Suggest Each and Every Claim Element

Fourth, it is respectfully submitted that the asserted combination of teachings from Takeda and Landau does not teach or suggest each and every element of any of claims 1 through 34, 49, 50, 54, 55, or 57.

Independent claims 1 and 9, as amended and presented herein, recite methods for preparing a digital object to be rendered. The methods of independent claims 1 and 9 include sorting data representative of at least three vertices of at least one polygon of the digital object, generating an orientation decision variable based on relative positions of the at least three vertices, and calculating a cross product term of the at least one polygon following the act of sorting. The data is sorted on the basis of the relative vertical positions of the at least three vertices.

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While Takeda and Landau mention that a determination may be made as to whether or not each polygon of a digital image is front facing or back facing, and Landau notes that such a determination may be based on a cross product term of the data corresponding to each of at least three vertices of each polygon, Takeda and Landau both lack any teaching or suggestion that the data of the at least three vertices of that polygon may be sorted, based on relative vertical positions of the at least three vertices, prior to determining the cross product term or that a determination of the orientation (*i.e.,* an orientation decision variable) may be based on the sorted data. Therefore, Takeda and Landau, taken either together or separately, do not teach or suggest each and every element of amended independent claim 1 or amended independent claim 9.

Takeda and Landau do not teach or suggest each and every element of any of claims 2 through 8, among other reasons, because each of these claims depends either directly or indirectly from claim 1.

Takeda and Landau do not teach or suggest each and every element of any of claims 10 through 16, among other reasons, because each of these claims depends either directly or indirectly from claim 9.

In addition, with respect to claims 6 and 14, it is respectfully submitted that neither Takeda nor Landau teaches or suggests generating an orientation decision variable substantially concurrently with sorting the data of the at least three vertices.

Moreover, neither Takeda nor Landau teaches or suggests that an orientation decision variable may be generated after data of at least three vertices of a polygon has been sorted, as recited in claims 7 and 15.

Independent claims 17 and 26 recite systems for rendering images of digital objects. The systems of independent claims 17 and 26 include a first logic circuit that sorts data representative of at least three vertices of at least one polygon of the digital object, a second logic circuit that generates an orientation decision variable based on relative positions of the at least three vertices, and a third logic circuit that, following sorting of the at least three vertices, calculates a cross product term of the at least three vertices. As amended and presented herein, independent

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claims 17 and 26 recite that the first logic circuit sorts that data representative of the at least three vertices on the basis of their relative vertical positions.

Again, neither Takeda nor Landau, taken either together or individually, teaches or suggests calculating a cross product term of data of at least three vertices of a polygon after the data has been sorted. Further, neither Takeda nor Landau teaches or suggests making such a calculation after data has been sorted on the basis of the relative vertical positions of the at least three vertices.

Moreover, Takeda and Landau both lack any teaching or suggestion that an orientation decision variable may be generated based on relative vertical positions of at least three sorted vertices.

As such, it is respectfully submitted that Takeda and Landau, taken either together or separately, do not teach or suggest each and every element of either independent claim 17 or independent claim 26.

Takeda and Landau do not teach or suggest each and every element of any of claims 18 through 25, among other reasons, because each of these claims depends either directly or indirectly from claim 17.

Takeda and Landau do not teach or suggest each and every element of any of claims 27 through 34, among other reasons, because each of these claims depends either directly or indirectly from claim 26.

Additionally, Takeda and Landau both lack any teaching or suggestion that logic circuits which sort data of at least three vertices of a polygon and generate an orientation variable based on relative positions of the at least three vertices may operate substantially concurrently, as recited in claims 24 and 33.

Also, neither Takeda nor Landau includes any teaching or suggestion that a logic circuit that sorts data of at least three vertices of a polygon and a logic circuit that generates an orientation variable based on relative positions of the at least three vertices may comprise the same logic circuit, as recited in claims 25 and 34.

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Independent claim 49, as amended and presented herein, recites a method for rendering an image of a digital object. The method of independent claim 49 includes sorting data representative of positions of at least three vertices of a polygon of the digital object. Once the data has been sorted, a cross product term for the at least three vertices is determined, as is an orientation decision variable. Thereafter, while considering the orientation decision variable, a determination is made as to whether or not the polygon is front facing or back facing. This determination is made based at least in part on an actual orientation of the at least three vertices, a sign of the cross product term, and a sorted order of the at least three vertices. If the polygon is back facing, it is culled.

Amended independent claim 49 incorporates the limitations of claim 56, which the outstanding Office Action indicates is allowable over the combined teachings of Takeda and Landau. Therefore, withdrawal of the 35 U.S.C. § 103(a) rejection of amended independent claim 49 is respectfully requested.

Claims 50 Takeda and Landau do not teach or suggest each and every element of any of claims 50, 54, 55, or 57, among other reasons, because each of these claims depends either directly or indirectly from claim 49.

Additionally, it is respectfully submitted that Takeda and Landau both lack any teaching or suggestion that an orientation variable may be determined substantially concurrently with the sorting of data representative of positions of at least three vertices of a polygon of a digital object, as recited in claim 54.

Further, with respect to claim 55, it is respectfully submitted that neither Takeda nor Landau includes any teaching or suggestion that an orientation decision variable may be determined following the sorting of data representative of positions of at least three vertices of a polygon of a digital object.

Claim 53 has been canceled without prejudice or disclaimer, rendering the rejection thereof moot.

As Takeda and Landau do not teach or suggest each and every element of any of claims 1 through 34, 49, 50, 54, 55, or 57, it is respectfully submitted that a *prima facie* case of obviousness under 35 U.S.C. § 103(a) has not been established against any of these claims.

Takeda in View of Landau and Baltaretu

Claims 35 through 38, 40 through 47, 51, 52, 59 through 66 and 68 are rejected under 35 U.S.C. § 103(a) for reciting subject matter which is assertedly unpatentable over teachings from Takeda, in view of Landau and further in view of U.S. Patent 6,437,780 to Baltaretu et al.(hereinafter "Baltaretu").

The teachings of Takeda and Landau have been summarized above.

Baltaretu also teaches a process for determining a cross product term for the vertices of a polygon. Col. 17, lines 20-39. Baltaretu does not, however, teach that sorting of the data corresponding to the vertices may occur before the cross product term is determined. Rather, at col. 17, lines 46-58, Baltaretu teaches that any sorting of vertex data occurs *after* the cross product term has been calculated, noting that the "vertex sorter . . . uses the deltas" that were determined in calculating the cross product term "to determine the order of the three vertices relative to one another." Col. 17, lines 49-51.

As noted in the outstanding Office Action, these acts are effected in order to facilitate a determination of whether or not tiles on a computer screen are covered by a convex polygon. Office Action, page 12; Baltaretu, col. 2, lines 54-64.

It is respectfully submitted that there are several reasons that the asserted combination of references does not support a *prima facie* case of obviousness under 35 U.S.C. § 103(a) against any of claims 35, 36, 41 through 47, 51, 52, 59 through 66, or 68.

As each of claims 37, 38, and 40 has been canceled without prejudice or disclaimer, it is respectfully submitted that the 35 U.S.C. § 103(a) rejections of these claims are moot.

Independent claim 35 has been amended to incorporate limitations from claim 39, which, as the outstanding Office Action indicates, recites allowable subject matter. Therefore, it is

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respectfully submitted that the 35 U.S.C. § 103(a) rejection of amended independent claim 35, as well as the rejections of claims 36 and 41 through 47 depending therefrom are moot.

Independent claim 49, from which claims 51 and 52 depend, has also been amended to include subject matter which the Office has indicated is allowable over the combined teachings of Takeda, Landau, and Baltaretu; *i.e.,* the subject matter recited in prior claim 56. Accordingly, both claim 51 and claim 52 are allowable for depending from an allowable independent claim.

The ensuing remarks are applicable to the subject matter recited in claims 59 through 66 and 68.

No Reasonable Expectation of Success

First, it is respectfully submitted that one of ordinary skill in the art would have had no reason to expect that the asserted combination of teachings from Takeda, Landau, and Baltaretu would have been successful.

In particular, if the back face culling processes of Landau were employed, there would be no back facing polygon data to evaluate and no back facing polygons to display in accordance with the teachings of Takeda. Baltaretu does not provide any teachings that would selectively restore selected back facing polygons or otherwise remedy this problem.

Thus, one of ordinary skill in the art would have no reason to expect that incorporating the teachings of Landau and Baltaretu into the method of Takeda would be successful or result in the processes to which claims 59 through 66 and 68 are drawn.

Takeda Teaches Away from the Combination of References, As Asserted

Second, it is respectfully submitted that Takeda teaches away from combining the teachings thereof with those of Landau in the manner that has been asserted and that Baltaretu does not provide any teachings that would persuade one of ordinary skill in the art to make such a combination of reference teachings. Specifically, at page 18 of the outstanding Office Action, it is has been asserted that one of ordinary skill in the art would have been motivated "to combine the polygon data processing techniques used in Takeda . . . with the back-face culling system of

Landau . . . in order to implement a system utilizing the above-techniques to render *only front-facing polygons*, rather than those which are hidden from view . . ."

The entire purpose of the process taught in Takeda is, however, to display polygons that would otherwise be hidden from view. Thus, Takeda teaches away from combining the teachings thereof with teachings from a reference, such as Landau, that would prevent rendering or displaying back facing polygons.

Therefore, it is respectfully submitted that the Office has not established a *prima* facie case of obviousness against any of claims 59 through 66, or 68 under 35 U.S.C. § 103(a).

There Would Have Been No Motivation to Combine the Teachings of Takeda, Landau, and Baltaretu

Third, it is respectfully submitted that one of ordinary skill in the art would not have been motivated to combine the teachings of Takeda, Landau, and Baltaretu in the manner that has been asserted.

In particular, while Baltaretu teaches sorting data that corresponds to the vertices of a polygon in connection with the calculation of a cross product term, the teachings of Baltaretu appear to be limited to conducting such sorting only after the cross product term has been calculated. Baltaretu teaches that the cross product term of a polygon is determined by a "delta calculator," then sent to a "vertex sorter," which sorts the data based on its relative positioning from left to right. Col. 17, lines 20-59. Thus, Baltaretu does not remedy the deficiencies of Takeda and Landau with respect to calculating a cross product term or determining an orientation (front facing or back facing) of a polygon during or after sorting of the data that corresponds to the vertices of the polygon, as required by claims 59 through 66, and 68. Thus, it is respectfully submitted that none of Takeda, Landau, or Baltaretu, nor the knowledge generally available in the art before the filing date of the above-referenced application would have provided one of ordinary skill in the art with any motivation to combine the teachings of these references in the manner that has been asserted.

Further, as this particular teaching is not present in any of the cited references, but is found in the specification of the above-referenced application, it appears that any motivation to

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combine the teachings of Takeda, Landau, and Baltaretu in the manner that has been asserted could only have been improperly based upon the hindsight provided by the teachings of the above-referenced application.

Takeda, Landau, and Baltaretu Do Not Teach or Suggest Each and Every Claim Element

Fourth, it is respectfully submitted that Takeda, Landau, and Baltaretu, taken either together or individually, do not teach or suggest each and every element of any of claims 59 through 66 or 68.

Independent claim 59 is directed to a method for rendering an image of a digital object that includes a plurality of polygons. The method of independent claim 59 includes sorting data representative of at least three vertices of each polygon of the image. Once the data has been sorted, an orientation of the at least three vertices is determined based on a sorted order of the data. Thereafter, a determination is made as to whether or not the orientation of the at least three vertices of each polygon has changed from an actual orientation of the at least three vertices of that polygon. If the orientation of a polygon has changed, it is culled.

None of Takeda, Landau, or Baltaretu, taken either together or separately, teaches or suggests sorting data representative of at least three vertices of a polygon *before* determinations are made about the orientation of the at least three vertices and about whether or not the orientation of the at least three vertices has changed, then culling the polygon if the orientation has changed. Therefore, it is respectfully submitted that none of Takeda, Landau, or Baltaretu teaches or suggests each and every element independent claim 59.

Takeda, Landau, and Baltaretu do not teach or suggest each and every element of any of claims 60 through 66 or 68, among other reasons, because each of these claims depends either directly or indirectly from claim 59.

It is additionally submitted that none of Takeda, Landau, or Baltaretu teaches or suggests calculating a cross product term for each polygon of an image based on sorted data representative of at least three vertices of that polygon.

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In view of the foregoing, it is respectfully submitted that a *prima facie* case of obviousness under 35 U.S.C. § 103(a) has not been established against any of claims 35, 36, 41 through 47, 51, 52, 59 through 66, or 68.

For these reasons, withdrawal of the 35 U.S.C. § 103(a) rejections of claims 1 through 38, 40 through 47, 49-55, 57, 59 through 66, and 68 is respectfully requested.

Allowable Subject Matter

The indication that claims 39, 48, 56, 58, and 67 recite allowable subject matter is gratefully acknowledged. Limitations from claim 39 have been incorporated into independent claim 35. Limitations from claim 48 appear in new independent claim 69. Limitations from claim 56 have been incorporated into independent claim 49. Claim 67 has not been amended to independent form because it is believed that claim 59, from which claim 67 depends, is allowable for the reasons that have been set forth hereinabove.

New Claims

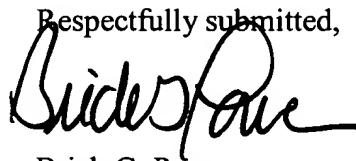New claims 69 through 81 have been added.

New claim 69 is an independent claim that includes the limitations of prior claims 35, 45, and 48. New claims 70 through 81 depend from new independent claim 69. Claims 70 through 72 and 74 through 81 recite similar subject matter to that respectively recited in claims 36 through 44, 46, and 47 prior to this Amendment. New claim 73 further limits the subject matter recited in claim 72.

It is respectfully submitted that none of new claims 69 through 81 introduces new matter into the above-referenced application.

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CONCLUSION

It is respectfully submitted that each of claims 1 through 36, 41 through 52, 54, 55, and 57 through 81 is allowable. An early notice of the allowability of each of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully submitted,

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